

Opposing Views

Attachment #4

**This Attachment Contains Scientific
Conclusions from Research by Scientists not
affiliated with the USFS. They all show that
Road Construction Damages
(and sometimes destroys) the Proper
Ecological Functioning of some Essential
Natural Resources in the Forest**

When planning timber sales most USFS Rangers and Supervisors routinely accept the aquatic habitat destruction and water quality degradation that their proposed new logging roads will inflict to the streams in and downstream from the sale area. Since their first year with the USFS they have been deluged by their supervisors with information telling them “team players” will trade away other resource health for timber harvest.

There is still a handful of competent, professional USFS Rangers and Supervisors who don't propose new roads because they acknowledge there are already 413,000 miles of existing system road in the national forest system ... enough to reach the moon and 19% back. Some of the Opposing View quotes below are authored by USFS employees, yet line-officers still believe plundering the forest's natural resources with roads is acceptable if the roads access more volume.

Sadly, the USFS fisheries biologists and hydrologists who are paid to protect the aquatic resources obediently look the other way. The USFS teaches them there are mitigation measures that eliminate the possibility of road-generated sediment from entering streams. They don't understand that eliminating rain and snow is the only way to eliminate sediment generated from road surfaces.

Anyone with land values and ethics who seriously reads the science below wouldn't allow themselves to be associated with projects that propose new road construction ... system or temporary.

Sadly, there are some USFS line-officers who are witlessly seeking volume at any cost to the forest's amenity resources that will refuse to read or ignore the following opposing views.

Please open the following link to view color photos of what the scientists describe below. The roads in the pictures received mitigation to prevent erosion.

<http://www.bing.com/images/search?q=road+forest+sediment+erosion&qpv=road+forest+sediment+erosion&FORM=IGRE>

FS Response to the document as a whole: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *"Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use."* No new permanent road construction is proposed with this project.

The following 17 Road Construction Opposing Views were authored by USFS employees

Road Construction Opposing View "Roads are associated with high sediment inputs and altered hydrology, both of which can strongly influence downstream channel habitats. Roads are also important as a source of indirect human impacts and as an agent of vegetation change and wildlife disturbance."

"Any ground disturbance increases the potential for erosion and hydrologic change, and roads are a major source of ground disturbance in wildlands. Compacted road surfaces generate overland flow, and much of this flow often enters the channel system, locally increasing peak flows. Localized peak flows are also increased where roads divert flow from one swale into another, and where roadcuts intercept subsurface flows."

"Overland flow from the road surface is a very effective transport medium for the abundant fine sediments that usually are generated on road surfaces. Road drainage also can excavate gullies and cause landslides downslope in swales. Cut and fill slopes

are often susceptible to landsliding, and road-related landsliding is the most visible forestry-related erosional impact in many areas."

What do we know about Roads?

By Reid, Leslie M. Ph.D., Robert R. Ziemer Ph.D., USDA Forest Service Pacific Southwest Research Station, and Michael J. Furniss, USDA Forest Service Six Rivers National Forest, 1994

<http://www.fs.fed.us/psw/publications/reid/4Roads.htm>

FS Response: Broken link.

Road Construction Opposing View "Fragmentation caused by roads is of special interest because the effects of roads extend tens to hundreds of yards from the roads themselves, altering habitats and water drainage patterns, disrupting wildlife movement, introducing exotic plant species, and increasing noise levels. The land development that follows roads out into rural areas usually leads to more roads, an expansion process that only ends at natural or legislated barriers."

Forest Fragmentation and Roads

Published by the Eastern Forest Environmental Threat Assessment Center, October 17, 2017
U.S. Forest Service - Southern Research Station

<https://forestthreats.org/products/publications/su-srs-018/fragmentation>

FS Response: Agreed. See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *"Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity."*

Road Construction Opposing View "Our analysis also indicated that >70 percent of the 91 species are affected negatively by one or more factors associated with roads."

"Roads in forested areas increase trapping pressures for martens and fishers, resulting in significantly higher captures in roaded versus unroaded areas (Hodgman and others 1994) and in logged versus unlogged areas, in which the difference was again attributed to higher road densities in logged stands (Thompson 1994). Secondary roads also might increase the likelihood that snags and logs will be removed for fuel wood. This could impact fishers, martens and flammulated owls, and also could have a negative effect on the prey base for goshawks (Reynolds and others 1992)."

Forest Road Erosion, Sediment Transport and Model Validation in the Southern Appalachians

By Dr. Mark S. Riedel, Research Hydrologist, USDA Forest Service, Otto, NC, and

Dr. James M. Vose, Project Leader, USDA Forest Service, Otto, NC

Presented at the Second Federal Interagency Hydrologic Modeling Conference, July 28 – August 1, 2002.

http://www.srs.fs.usda.gov/pubs/ja/ja_riedel002.pdf

FS Response: Link broken.

Road Construction Opposing View "We conclude that habitat quality for Ovenbirds may be lower within 150 m of unpaved roads in extensive forested landscapes, affecting territory density and possibly reproductive success."

Effects of forest roads on habitat quality for Ovenbirds in a forested landscape

By Ortega, Yvette K.; USFS ecologist, Rocky Mountain Research Station, Missoula Montana, and Capen, David E.

Published in *Auk*. 116(4): 937-946, 1999

<https://www.fs.usda.gov/treearch/pubs/28532>

FS Response: Agreed. See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *"Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity."* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View "Almost everywhere people live and work they build and use unimproved roads, and wherever the roads go, a range of environmental issues follows."

"Among the environmental effects of unimproved roads, those on water quality and aquatic ecology are some of the most critical. Increased chronic sedimentation, in particular, can dramatically change the food web in affected streams and lakes."

"The nearly impervious nature of road surfaces (or treads) makes them unique within forested environments and causes runoff generation even in mild rainfall events, leading to chronic fine sediment contributions."

"If we look at the issue of what we need to learn or the research priorities for forest road hydrology, I would argue that the areas of cutslope hydrology and effectiveness of restoration efforts are perhaps most critical."

"At a few sites in the mountains of Idaho and Oregon a substantial portion of the road runoff (80–95%) came from subsurface flow intercepted by the cutslope (Burroughs *et al.*, 1972; Megahan, 1972; Wemple, 1998)."

Hydrological processes and pathways affected by forest roads: what do we still need to learn?

By Luce, Charles H. Ph.D., USFS, Rocky Mountain Research Station, Boise Aquatic Sciences Laboratory, 2002

<https://www.fs.usda.gov/treearch/pubs/23954>

FS Response: See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Road Construction Opposing View "Roads and skid trails have been identified as a major contributor to increased turbidity of water draining logging areas resulting in increases from 4 to 93 parts per million (Hoover, 1952). Forest roads have been found to have erosion rates from one to three orders of magnitude greater than similar undisturbed areas (Megahan, 1974) and perhaps account for as much as 90 percent of all forest erosion (Megahan, 1972). Forest roads can also cause soil erosion and stream sedimentation, which adversely impact on the nation's water quality (Authur *et al.*, 1998)." (pg 304)

2003. "Minimizing the impacts of the forest road system."

By Grace, Johnny M. III Ph.D., Research Engineer, Southern Research Station, USDA Forest Service

Published in the Proceedings of the conference 34 international erosion control association; ISSN 1092-2806.

http://www.srs.fs.usda.gov/pubs/ja/ja_grace011.pdf

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View "Research has shown that roads can have adverse impacts on the water quality on the forest landscape (Authur et al. 1998; Binkley and Brown 1993; Megahan et al. 1991). The forest road system has been identified by previous research as the major source of soil erosion on forestlands (Anderson et. al 1976; Patric 1976; Swift 1984; Van Lear et al. 1997). Furthermore, roads are cited as the dominant source of sediment that reaches stream channels (Packer 1967; Trimble and Sartz 1957; Haupt 1959)."

Sediment Plume Development from Forest Roads: How are they related to Filter Strip Recommendations?

By J McFero Grace III, USFS research engineer, US Forest Service, G.W. Andrews Forestry Sciences Lab

An ASAE/CSAE Meeting Presentation, Paper Number: 045015, August 1-4, 2004.

http://www.srs.fs.usda.gov/pubs/ja/ja_grace017.pdf

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View "Road effects are far more pervasive than originally believed and include such disparate consequences as population and habitat fragmentation, accelerated rates of soil erosion, and invasion of exotic plants along roadways. Indeed, "in public wildlands management, road systems are the largest human investment and the feature most damaging to the environment" (Gucinski et al. 2001:7). Summaries of the effects of roads on wildlife habitats and biological systems in general have been compiled by Forman and Alexander (1998), Trombulak and Frissell (2000), Gucinski et al. (2001), Forman et al. (2003) and Gaines et al. (2003)."

Effects of Roads on Elk: Implications for Management in Forested Ecosystems

By Mary M. Rowland, *U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station*, Michael J. Wisdom, *U. S. Department of Agriculture, Forest Service, Pacific Northwest Research Station*, Bruce K. Johnson, *Oregon Department of Fish and Wildlife*, and Mark A. Penninger *U. S. Department of Agriculture, Forest Service, Wallowa- Whitman National Forest*.

Published in the Transactions of the 69th North American Wildlife and Natural Resources Conference, March 16 to 20, 2004

http://www.fs.fed.us/pnw/pubs/journals/pnw_2004_rowland001.pdf

FS Response: Agreed. See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. "Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity." Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View "Disturbances from roadbuilding and logging changed the sediment/discharge relationship of the South Fork from one which was supply dependent to one which was stream power dependent, resulting in substantial increases in suspended sediment discharges."

"Road construction and logging appear to have resulted in increases in average turbidity levels (as inferred from suspended sediment increases) above those permitted by Regional Water Quality Regulations."

Watershed's Response to Logging and Roads: South Fork of Caspar Creek, California, 1967-1976

Rice, Raymond M. Ph.D., Forest B. Tilley and Patricia A. Datzman.
USDA Forest Service, *Research Paper PSW-146*, 1979
<http://www.fs.fed.us/psw/publications/rice/Rice79.pdf>

FS Response: Dated material. Forest Service policy has changed in response to research like this. See the EA for effects to all resources.

Road Construction Opposing View "Roads are often the major source of soil erosion from forested lands (Patric 1976)."

"Generally, soil loss is greatest during and immediately after construction."

Soil losses from roadbeds and cut and fill slopes in the Southern Appalachian Mountains

Swift Jr., L. W., research forester, USDA Forest Service, Southeastern Forest Experiment Station, Coweeta Hydrologic Laboratory,
Reprinted from the *Southern Journal of Applied Forestry* 8: 209-216. 1984.
<http://cwt33.ecology.uga.edu/publications/403.pdf>

FS Response: Dated material. Forest Service policy has changed in response to research like this. See the EA for effects to all resources.

Road Construction Opposing View "Few marks on the land are more lasting than roads."

"The negative effects on the landscape of constructing new roads, deferring maintenance, and decommissioning old roads are well documented. Unwanted or non-native plant species can be transported on vehicles and clothing by users of roads, ultimately displacing native species. Roads may fragment and degrade habitat for wildlife species and eliminate travel corridors of other species. Poorly designed or maintained roads promote erosion and landslides, degrading riparian and wetland habitat through sedimentation and changes in streamflow and water temperature, with associated reductions in fish habitat and productivity. Also, roads allow people to travel into previously difficult or impossible to access areas, resulting in indirect impacts such as ground and habitat disturbance, increased pressure on wildlife species, increased litter, sanitation needs and vandalism, and increased frequency of human-caused fires."

National Forest System Road Management

Federal Register: March 3, 2000 (Volume 65, Number 43) Page 11675

A Notice by the Forest Service on 03/03/2000, signed by USFS Chief Dr. Mike Dombeck on February 25, 2000

<https://www.federalregister.gov/documents/2000/03/03/00-5002/national-forest-system-road-management>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *"Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use."* No new permanent road construction is proposed with this project.

Road Construction Opposing View"In the Pacific Northwest, the two main processes that contribute to sediment production are mass failure and surface erosion from forest roads (Fredriksen 1970, Reid and Dunne 1984). In the Clearwater River basin in the

State of Washington, as much as 40 percent of the sediment produced in the watershed was attributed to logging roads (Reid 1980)."

A Method for Measuring Sediment Production from Forest Roads

By Kahklen, Keith, the Natural Resources Manager for the Bureau of Indian Affairs

Published by the Pacific Northwest Research Station, USDA Forest Service. Research note PNW-RN-529, April 2001.

<http://www.fs.fed.us/pnw/pubs/rn529.pdf>

FS Response: This is a paper outlining methods for measuring sediment production from forest roads. No response required.

Road Construction Opposing View "Rarely can roads be designed and built that have no negative impacts on streams. Roads modify natural drainage patterns and can increase hillslope erosion and downstream sedimentation. Sediments from road failures at stream crossings are deposited directly into stream habitats and can have both on-site and off-site effects. These include alterations of the channel pattern or morphology, increased bank erosion and changes in channel width, substrate composition, and stability of slopes adjacent to the channels."

Diversion Potential at Road-Stream Crossings

By Furniss, Michael J., Michael Love Ph.D. and Sam A. Flanagan

Published by the USDA Forest Service. 9777 1814—SDTDC. December 1997.

https://www.fs.fed.us/eng/pubs/html/wr_p/97771814/97771814.htm

FS Response: Document describing stream and road crossings. No response required.

Road Construction Opposing View "Surface erosion from road surfaces, cutbanks, and ditches represents a significant and, in some landscapes, the dominant source of road-related sediment input to streams. Increased sediment delivery to streams after road building has been well documented in the research literature in the Pacific Northwest and Idaho (Bilby and others 1989, Donald and others 1996, Megahan and Kidd 1972, Reid and Dunne 1984, Rothacher 1971, Sullivan and Duncan 1981) and in the Eastern United States (Kochenderfer and others 1997, Swift 1985, 1988). Rates of sediment delivery from unpaved roads appear highest in the initial years after building (Megahan and Kidd 1972)" (pg 23)

“Roads interact directly with stream channels in a variety of ways, depending on orientation to streams (parallel, orthogonal) and landscape position (valley bottom, midslope, ridge). The geomorphic consequences of these interactions, particularly during storms, are potentially significant in terms of erosion rates, direct and off-site effects on channel morphology, and drainage network structure, but they are complex and often poorly understood.” (pg 24)

“*Findings:* Habitat loss has broader effects than just the conversion of a small area of land to road surfaces. Roads fragment by changing landscape structure and by directly and indirectly affecting species. Habitat effects of roads on the landscape include dissecting vegetation patches, increasing the edge-affected area and decreasing interior area, and increasing the uniformity of patch characteristics, such as shape and size (Reed and others 1996). Whenever forest roads are built, changes in habitat and modified animal behavior will lead to changes in wildlife populations (Lyon 1983).” (pgs 30 and 31)

“The effects of roads are not limited to those associated with increases in fine-sediment delivery to streams; they can include barriers to migration, water temperature changes, and alterations to streamflow regimes.” (pg 34)

“*Findings:* Roads contribute more sediment to streams than any other land management activity (Gibbons and Salo 1973, Meehan 1991), but most land management activities, such as mining, timber harvest, grazing, recreation, and water diversions depend on roads. Most of the sediment from timber harvest activities is related to roads and road building (Dunne and Leopold 1978, Megahan and others 1978, MacDonald and Ritland 1989, Chamberlain and others 1991, Furniss and others 1991) and the associated increases in erosion rates (Swanson and Dyrness 1975, Swanston and Swanson 1976, Beschta 1978, Gardner 1979, Reid and Dunne 1984, Meehan 1991, Reid 1993, Rhodes and others 1994).” (pg 36)

Forest Service Roads: A Synthesis of Scientific Information, June, 2000

Edited by: Hermann Gucinski, USFS, Pacific Northwest Research Station Corvallis, OR
Michael J. Furniss, USFS, Rocky Mtn Res. Station, Stream Systems Technology Center, Fort Collins, CO.
Robert R. Ziemer, USFS, Pacific Southwest Research Station, Arcata, CA
Martha H. Brookes, USFS, Pacific Northwest Research Station, Portland

https://www.fs.fed.us/eng/road_mgt/science.pdf

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 “Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.” No new

permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View "Debris slides over a 20-year period were inventoried on 137,500 acres of forested land in the Klamath Mountains of southwest Oregon. Frequency during the study period was about one slide every 4.3 years on each 1,000 acres-an erosion rate of about $1/2 \text{ yd}^3$ per acre per year. Erosion rates on roads and landings were 100 times those on undisturbed areas, while erosion on harvested areas was seven times that of undisturbed areas. Three-quarters of the slides were found on slopes steeper than 70 percent and half were on the lower third of slopes."

"Soil erosion rates due to debris slides were many times higher on forests with roads, landings, and logging activity than on undisturbed forests."

Amaranthus, Mike P. Ph.D., Raymond M. Rice Ph.D., N. R. Barr and R. R. Ziemer Ph.D. "**Logging and forest roads related to increased debris slides in southwestern Oregon.**"

Journal of Forestry Vol. 83, No. 4. 1985.

Dr. Ziemer was a Forest Service Research & Development employee before he retired
<https://www.fs.usda.gov/treesearch/pubs/7683>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 "*Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.*" No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

End road construction-related resource destruction statements by USFS scientists

Road Construction Opposing View "Roads, on the other hand, cut into hillslopes and allow deep-soil water to surface and run rapidly to streams (Harr et al. 1975). In two watersheds on the H.J. Andrews Experimental Forest in the Oregon Cascades, for instance, peak stream flows were the same on a watershed that was 100 percent clearcut but had no roads and one that was only 25 percent clearcut but had roads (Jones and Grant 1996). For the first five years after harvest, peak flows averaged greater than 50 percent higher than before the cuts, then began to decline. However, 25 years after the harvest, peak flows were still higher by 25 to 40 percent." (page 6)

Applying Ecological Principles to Management of the U.S. National Forests

By John Aber Ph.D., Norman Christensen Ph.D., Ivan Fernandez, Jerry Franklin Ph.D., Lori Hiding, Malcolm Hunter Ph.D., James MacMahon, David Mladenoff Ph.D., John Pastor, David Perry, Ron Slangen, Helga van Miegroet Ph.D.

Issues in Ecology Number 6 Spring 2000

<https://cfpub.epa.gov/watertrain/pdf/issue6.pdf>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 "Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use." No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View "American rivers and streams face destruction by sedimentation. Clearcutting, along with the vast network of logging roads, result in sedimentation and soil erosion into our national forest's rivers and streams. Sedimentation degrades the water quality, impairs the habitat for fish and macroinvertebrates, and limits the ecosystem functions and services of streams."

By Dr. Seth Reice, Associate Professor of Biology in the Department of Biology and Curriculum in Ecology, University of North Carolina.

From Press Conference with Senator Robert Torricelli, April 28, 1998, U.S. Capitol regarding the proposed **Act to Save America's Forests** (S. 977, HR 1376)

<http://www.saveamericasforests.org/news/ScientistsStatement.htm>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No

new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View "Today, addressing the adverse impacts of forest roads is consistently identified as one of the highest watershed restoration priorities in U.S. forests—in many forested watersheds in the western United States there is a greater road density than stream density. It is simply irrational to spend millions of dollars subsidizing further forest road construction when we are simultaneously spending millions of dollars to offset detrimental effects associated with similar actions in the past."

By Dr. David Montgomery, Associate Professor for the Department of Geological Sciences at the University of Washington.

From Press Conference with Senator Robert Torricelli, April 28, 1998, U.S. Capitol

regarding the proposed **Act to Save America's Forests** (S. 977, HR 1376)

<http://www.saveamericasforests.org/news/ScientistsStatement.htm>

FS Response: Same link as above.

Road Construction Opposing View "Sediment input to freshwater is due to either the slower, large-scale process of soil erosion, or to rapid, localized "mass movements," such as landslides. Forest practices can increase the rate at which both processes occur. Most sediment from forestry arises from landslides from roads and clearcuts on steep slopes, stream bank collapse after riparian harvesting, and soil erosion from logging roads and harvested areas. Roads, particularly those that are active for long periods of time, are likely the largest contributor of forestry-induced sediment (Furniss et al. 1991)." (pg 27)

"Sediment can increase even when roads comprise just 3% of a basin (Cederholm et al. 1981)." (pg 27)

"More than half the species present in the study area will likely be negatively impacted by sedimentation from logging roads." (pg 27)

"In areas made highly turbid (cloudy) from sedimentation, the foraging ability of adults and juveniles may be inhibited through decreased algal production and subsequent declines in insect abundance, or, for visual-feeding taxa dependent on good light, through their inability to find and capture food. Highly silted water may damage gill tissue and cause mortality or physiological stress of adults and juveniles." (pg 27)

Evaluating effects of large-scale salvage logging for mountain pine beetle on terrestrial and aquatic vertebrates.

Bunnell, Fred L. Ph.D., Kelly A. Squires and Isabelle Houde
Mountain Pine Beetle Initiative Working Paper 1. Canadian Forest Service. 2004
<https://www.for.gov.bc.ca/hfd/library/documents/bib92944.pdf>

FS Response: Paper on salvage logging in mountain pine beetle struck areas. Not relevant to this project.

Road Construction Opposing View "Salmonid populations decreased immediately after the road construction." (pg 10)

"The road construction and right-of-way logging were immediately detrimental to most aquatic invertebrates in South Fork Caspar Creek" (pg 11)

"Sustained logging and associated road construction over a period of many years do not afford either the stream or the 'fish population a chance to recover." (pg 15)

Some Effects of Logging and Associated Road Construction on Northern California Streams.

Burns, James W.
Transactions of the American Fisheries Society, Volume 1, Number 1, January 1972.
<http://www.fs.fed.us/psw/publications/4351/Burns72.pdf>

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Road Construction Opposing View “Road construction in the steep, often unstable terrain of Oregon's mountains is both, difficult and hazardous. It is also costly, both in terms of direct construction and damage to the aquatic environment. We know that in Oregon, forest roads are our greatest source of problems with mass soil movement (Brown and, Krygier, 1971;Fredriksen, 1970; Dyrness, 1967). Yet we do not understand the processes well enough to be able to predict with reasonable certainty where road failures will occur or how alternative road designs will affect mass movements except in the most obvious places.” (pg 4)

The Impact of Timber Harvest on Soil and Water Resources

Brown, George W. Ph.D.

Dr. Brown is the Forest Hydrologist, School of Forestry, Oregon State University

<http://andrewsforest.oregonstate.edu/pubs/pdf/pub1695.pdf>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *“Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.”* No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Road networks crossing landscapes cause local hydrologic and erosion effects, whereas stream networks and distant valleys receive major peak-flow and sediment impacts. Chemical effects mainly occur near roads. Road networks interrupt horizontal ecological flows, alter landscape spatial pattern, and therefore inhibit important interior species.” (pg 207)

“Based on road-effect zones, an estimated 15–20% of the United States is ecologically impacted by roads.” (pg 207)

Roads and their Major Ecological Effects

By Forman, Richard T. and Lauren E. Alexander

Published in the *Annual Review of Ecology and Systematics*, Vol. 29: 207-231, November 1998

<https://gis.lic.wisc.edu/wwwlicgf/gliwfc/PolyMet/SDEIS/references/Forman%20and%20Alexander%201998.pdf>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 “Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.” No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Logging roads have a profound effect on forest ecosystems — increasing erosion and stream sedimentation, serving as vectors for diseases and invasive species, and fragmenting habitat.” (page 28)

Simplified Forest Management to Achieve Watershed and Forest Health: A Critique.

Franklin, Jerry Ph.D., David Perry Ph.D., Reed Noss Ph.D., David Montgomery Ph.D. and Christopher Frissell Ph.D. 2000.

A National Wildlife Federation publication sponsored by the Bullitt Foundation

<http://www.coastrange.org/documents/forestreport.pdf>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *“Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.”* No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “The authors warned that cutting roads into current roadless areas could bring much more harm to wildlife, soil and fisheries than the beetle-killed trees pose to the forest.”

Logging Won't Halt Beetles, Fire, Report Says

Frey, David

NewWest.net, 3-03-10

http://www.newwest.net/topic/article/logging_wont_halt_beetles_fire_report_says/C41/L41/

FS Response: Article about roads in existing Roadless areas. No new roads would be built in Roadless areas. Also not a bark beetle salvage project.

Road Construction Opposing View “Barry Noon, a professor of wildlife ecology at Colorado State University, noted that scientific research has consistently shown the adverse effects of roads on hydrologic processes and fish and wildlife populations.

“One of the key things to recognize is the effects of the roads extend far beyond their immediate footprint,” Noon said. For example, “in terms of hydrology, the roads are leading to faster runoff of water, often with great increases in sedimentation, particularly following storm events, and roads in watersheds often lead to increases in the intensity of floods.” “

These changes degrade fish habitat because of the increased sedimentation that leads to decreases in water quality, Noon said. And roads fragment wildlife habitat and create areas that animals avoid, often as result of increased hunting, he said.”

Battling beetles may not reduce fire risks – report

By Gable, Eryn, executive director of the **Xerces** Society for Invertebrate Conservation

Published by Xerces Society for Invertebrate Conservation, March 4, 2010

<http://www.xerces.org/2010/03/04/battling-beetles-may-not-reduce-fire-risks-report/>

FS Response: Article about salvaging in bark beetle killed stands. No response required.

Road Construction Opposing View “Many forested landscapes are fragmented by roads, but our understanding of the effects of these roads on the function and diversity of the surrounding forest is in its infancy. I investigated the effect of roads in otherwise continuous forests on the macroinvertebrate fauna of the soil. I took soil samples along transects leading away from the edges of unpaved roads in the Cherokee National Forest in the Southern Appalachian mountains of the United States. Roads significantly depressed both the abundance and the richness of the macroinvertebrate soil fauna. Roads also significantly reduced the depth of the leaf-litter layer. These effects persisted up to 100 m into the forest. Wider roads and roads with more open canopies tended to produce steeper declines in abundance, richness, and leaf-litter depth, but

these effects were significant only for canopy cover and litter depth. The macroinvertebrate fauna of the leaf litter plays a pivotal role in the ability of the soil to process energy and nutrients. These macroinvertebrates also provide prey for vertebrate species such as salamanders and ground-foraging birds. The effect of roads on the surrounding forest is compounded by the sprawling nature of the road system in this and many other forests. My data suggest that even relatively narrow roads through forests can produce marked edge effects that may have negative consequences for the function and diversity of the forest ecosystem.”

Effects of Forest Roads on Macroinvertebrate Soil Fauna of the Southern Appalachian Mountains

Haskell, David G. Ph.D.

Published in *Conservation Biology*, February 2000

<http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.2000.99232.x/abstract>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 “Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.” No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Roads remove habitat, alter adjacent areas, and interrupt and redirect ecological flows. They subdivide wildlife populations, foster invasive species spread, change the hydrologic network, and increase human use of adjacent areas. At broad scales, these impacts cumulate and define landscape patterns.”

Road Development, Housing Growth, and Landscape Fragmentation In Northern Wisconsin: 1937–1999

By Hawbaker, Todd J. Ph.D., Volker C. Radeloff Ph.D., Murray K. Clayton Ph.D., Roger B. Hammer Ph.D., and Charlotte E. Gonzalez-Abraham Ph.D.

Published in *Ecological Applications*: Vol. 16, No. 3, pp. 1222-1237.

<http://www.esajournals.org/doi/abs/10.1890/1051-0761%282006%29016%5B1222%3ARDHGAL%5D2.0.CO%3B2?journalCode=ecap>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *“Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.”* No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

[illegible]

Road Construction Opposing View “According to *The New York Times*, we now have more than 380,000 miles of logging roads nationwide -- enough to circle the globe 15 times, eight times the size of the interstate highway system. It is not uncommon to find 20 miles of logging road in a single square mile.

Last winter was unusually wet in the Pacific Northwest. The result was landslides all over caused by logging roads; five people died, spawning streams were ruined, water supplies were contaminated, and the flooding was tremendously aggravated. According to David Bayles, conservation director of the Pacific Rivers Council, aerial surveys documented more than 650 landslides in February in Washington and Oregon alone. The stupidest and most dangerous practice is allowing logging roads on steep slopes -- that's really asking for it.

You may ask yourself why the taxpayers are expected to pony up to build roads for profitable logging companies.”

We're going out on a limb, and for what?

By Ivins, Molly

Published in the *Star-Telegram*, August 2, 1997

<http://www.metla.fi/archive/forest/1997/09/msg00017.html>

FS Response: Broken link.

[illegible]

Road Construction Opposing View “Forested watersheds typically release clean water, yet forest roads and trails can drastically impact water quality. Increased stream

sedimentation from road and skid trail crossings represent the most significant water quality threat associated with forestry operations.”

Forest Roads and Sediment Project

By W. Mike Aust, Ph.D., Kevin McGuire, Ph.D., M. Chad Bolding, Ph.D. and Scott Barrett, Ph.D.

Published by Virginia Tech University, 2017

<http://hydro.vwrrc.vt.edu/research/projects/forest-roads-and-sediment-project/>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View "Although disturbance patches are created by peak flow and debris flow disturbances in mountain landscapes without roads, roads can alter the landscape distributions of the starting and stopping points of debris flows, and they can alter the balance between the intensity of flood peaks and the stream network's resistance to change."

Effects of roads on hydrology, geomorphology, and disturbance patches in stream networks

By: Jones, Julia A. Ph.D., Frederick J. Swanson Ph.D. Beverley C. Wemple Ph.D., and Kai U. Snyder.

Published in *Conservation Biology* 14, No. 1. 2000.

https://www.researchgate.net/publication/227626455_Effects_of_Roads_on_Hydrology_Geomorphology_and_Disturbance_Patches_in_Stream_Networks

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 "Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use." No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View "The compaction of forest road soils is known to reduce aeration, porosity, infiltration rates, water movement, and biological activity in soils."

"Physical disturbances caused by road construction and vehicle use create ideal conditions for colonization by invasive exotic plant species. The use of roads by vehicles, machinery, or humans often aids the spread of exotic plant seeds. Once established, they can have long-term impacts on surrounding ecosystems and can be difficult to remove."

"Roads are known to cause habitat fragmentation. Many create ecological 'edges' with different plant species, light levels, and hiding cover, all of which may alter animal survival, reproductive success, and movement patterns. The introduction of exotic plants can disrupt the availability of native vegetation used by wildlife for food and shelter (Trombulak and Frissell 1999)."

"Forest roads often develop a water-repellent soil layer caused by lack of vegetative cover and changes in soil composition. This can substantially influence how runoff is processed. Erosion, the formation of water channels beside the road, and increased sediment loads in nearby streams are common results of this process (Baker 2003)."

"Because they provide easier access to many forest tracts, forest roads often allow more human-caused fires to be ignited."

Restoring Forest Roads

A Northern Arizona University Ecological Restoration Institute publication, 2017

<https://nau.edu/ERI/Resources/For-Practitioners/Restoring-Forest-Roads/>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View "Overall, roads had a greater impact on landscape structure than logging in our study area. Indeed, the 3-fold increase in road density between 1950–1993 accounted for most of the changes in landscape configuration associated with mean patch size, edge density, and core area."

Cumulative effects of roads and logging on landscape structure in the San Juan Mountains, Colorado (USA)

By: McGarigal, Kevin Ph.D., William H. Romme Ph.D., Michele Crist Ph.D. and Ed Roworth Ph.D.

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View “Road construction in remote areas appears to be the major long term impact of resource extraction industries and the most significant problem facing grizzly bears in most locations. Open roads are an influence in all 5 ways that people affect bears. Vehicles on roads can harass bears, displace them from quality habitats, and cause reduced bear use of altered habitats, such as cutting units. Bears that are displaced from roads may cause social disruption in areas away from roads. Finally, roads permit access for many people and some of these will shoot bears.” (Pg. 62)

Relationships between Human Industrial Activity and Grizzly Bears

Author(s): Bruce N. McLellan

Source: Bears: Their Biology and Management, Vol. 8, A Selection of Papers from the Eighth International Conference on Bear Research and Management, Victoria, British Columbia, Canada, February 1989 (1990), pp. 57-64

Published by: International Association of Bear Research and Management

http://www.bearbiology.com/fileadmin/tpl/Downloads/URSUS/Vol_8/McClellan_8.pdf

FS Response: Project is not in grizzly bear habitat. Thank you for your comment.

Road Construction Opposing View “Erosion from forest roads can be a large source of sediment in watersheds managed for timber production.”

Predicting Road Surface Erosion from Forest Roads in Washington State

By Megahan, Walter F. Ph.D.

from a presentation presented at the 2003 Geological Society of America meeting.

http://gsa.confex.com/gsa/2003AM/finalprogram/abstract_67686.htm

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No

new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View “Today, addressing the adverse impacts of forest roads is consistently identified as one of the highest watershed restoration priorities in U.S. forests—in many forested watersheds in the western United States there is a greater road density than stream density. It is simply irrational to spend millions of dollars subsidizing further forest road construction when we are simultaneously spending millions of dollars to offset detrimental effects associated with similar actions in the past.”

Statement at a Press Conference with Senator Robert Torricelli about S. 977 and HR 1376), the Act to Save America’s Forests

By Montgomery, David Ph.D.

April 28, 1998, U.S. Capitol

<http://www.saveamericasforests.org/news/ScientistsStatement.htm>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View “Nothing is worse for sensitive wildlife than a road. Over the last few decades, studies in a variety of terrestrial and aquatic ecosystems have demonstrated that many of the most pervasive threats to biological diversity - habitat destruction and fragmentation, edge effects, exotic species invasions, pollution, and overhunting - are aggravated by roads. Roads have been implicated as mortality sinks for animals ranging from snakes to wolves; as displacement factors affecting animal distribution and movement patterns; as population fragmenting factors; as sources of sediments that clog streams and destroy fisheries; as sources of deleterious edge effects; and as access corridors that encourage development, logging and poaching of rare plants and animals.”

The Ecological Effects of Roads or the Road to Destruction

Noss, Reed F., Ph.D.

Published by *Wildlands CPR*, 1995

<https://www.wildwill.net/blog/2015/08/13/the-ecological-effects-of-roads/>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *“Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.”* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Fragmentation affects animal populations in a variety of ways, including decreased species diversity and lower densities of some animal species in the resulting smaller patches. This study seeks to quantify the effects of roads and logging activities on forest habitat.”

“Roads precipitate fragmentation by dissecting previously large patches into smaller ones, and in so doing they create edge habitat in patches along both sides of the road, potentially at the expense of interior habitat. As the density of roads in landscapes increases, these effects increase as well.”

Contribution of Roads to Forest Fragmentation in the Rocky Mountains

Reed, Rebecca Ph.D., Johnson-Barnard, Julia Ph.D., and Baker, William P.D.

Published in *Conservation Biology*, August, 1996

<http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.1996.10041098.x/abstract>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *“Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.”* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Erosion on roads is an important source of fine-grained sediment in streams draining logged basins of the Pacific Northwest. Runoff rates and sediment concentrations from 10 road segments subject to a variety of traffic levels were monitored to produce sediment rating curves and unit hydrographs for different use levels and types of surfaces. These relationships are combined with a continuous rainfall record to calculate mean annual sediment yields from road segments of each use level. A heavily used road segment in the field area contributes 130 times as much sediment as an abandoned road. A paved road segment, along which cut slopes and ditches are the only sources of sediment, yields less than 1% as much sediment as a heavily used road with a gravel surface.”

Sediment Production from Forest Road Surfaces

By Reid, L. M. Ph.D. and T. Dunne

Published in WATER RESOURCES RESEARCH, VOL. 20, NO. 11, PAGES 1753-1761, NOVEMBER, 1984

https://www.fs.fed.us/psw/publications/reid/psw_1984_reid001.pdf

FS Response: Best management practices were developed in the 80's as a way to help control and reduce sediment production and delivery to streams. This project will use developed best management practices and site specific design criteria to mitigate the risk of sediment production and delivery.

Road Construction Opposing View “The effects of forest roads on hydrology are related to the effects of forest clearing. Most logging requires road access, and the roads often remain after the logging, so there are both short and long-term effects.⁹⁴ Forest road surfaces are relatively impermeable. Water readily runs over the road surface and associated roadside ditches, often directly to a stream channel, with the net effect of extending channel networks and increasing drainage density.⁹⁵ In addition to providing conduits for overland flow, forest roads involve slope-cuts and ditching that may intersect the water table and interrupt natural subsurface water movement.⁹⁶ This diversion of subsurface water may be quantitatively more important than the overland flow of storm water in some watersheds.⁹⁷ The importance of roads in altering basin hydrology has been underscored in paired-watershed studies and recent modeling studies.⁹⁸” (Pgs. 730 and 731)

Water Quantity and Quality in the Mountain Environment

Shanley, James B. and Beverley Wemple Ph.D.

Published in the *Vermont Law Review*, Vol. 26:717, 2002

http://www.uvm.edu/~bwemple/pubs/shanley_wemple_law.pdf

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 “*Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.*” No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Roads are a widespread and increasing feature of most landscapes. We reviewed the scientific literature on the ecological effects of roads and found support for the general conclusion that they are associated with negative effects on biotic integrity in both terrestrial and aquatic ecosystems. Roads of all kinds have seven general effects: mortality from road construction, mortality from collision with vehicles, modification of animal behavior, alteration of the physical environment, alteration of the chemical environment, spread of exotics, and increased use of areas by humans. Road construction kills sessile and slow-moving organisms, injures organisms adjacent to a road, and alters physical conditions beneath a road. Vehicle collisions affect the demography of many species, both vertebrates and invertebrates; mitigation measures to reduce roadkill have been only partly successful. Roads alter animal behavior by causing changes in home ranges, movement, reproductive success, escape response, and physiological state. Roads change soil density, temperature, soil water content, light levels, dust, surface waters, patterns of runoff, and sedimentation, as well as adding heavy metals (especially lead), salts, organic molecules, ozone, and nutrients to roadside environments. Roads promote the dispersal of exotic species by altering habitats, stressing native species, and providing movement corridors. Roads also promote increased hunting, fishing, passive harassment of animals, and landscape modifications. Not all species and ecosystems are equally affected by roads, but overall the presence of roads is highly correlated with changes in species composition, population sizes, and hydrologic and geomorphic processes that shape aquatic and riparian systems. More experimental research is needed to complement post-hoc correlative studies. Our review underscores the importance to conservation of avoiding construction of new roads in roadless or sparsely roaded areas and of removal or restoration of existing roads to benefit both terrestrial and aquatic biota.”

Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities

By Trombulak, Stephen C. Ph.D. and Christopher A. Frissell Ph.D.

Published in *Conservation Biology*, Volume 14, No. 1, Pages 18–30, February 2000

<http://onlinelibrary.wiley.com/doi/10.1046/j.1523-1739.2000.99084.x/full>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. “Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.” Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View "Roads are a major contributor to habitat fragmentation because they divide large landscapes into smaller patches and convert interior habitat into edge habitat. As additional road construction and timber harvest activities increase habitat fragmentation across large areas, the populations of some species may become isolated, increasing the risk of local extirpations or extinctions (Noss and Cooperrider 1994)."

"Habitat fragmentation creates landscapes made of altered habitats or developed areas fundamentally different from those shaped by natural disturbances that species have adapted to over evolutionary time (Noss and Cooperrider 1994 **in** Meffe et al. 1997). Adverse effects of habitat fragmentation to both wildlife populations and species include:

"Increased isolation of populations or species, which leads to:

- Adverse genetic effects; i.e. inbreeding depression (depressed fertility and fecundity, increased natal mortality) and decreased genetic diversity from genetic drift and bottlenecks,
- Increased potential for extirpation of localized populations or extinction of narrowly distributed species from catastrophic events such as hurricanes, wildfires or disease outbreaks,
- Changes in habitat vegetative composition, often to weedy and invasive species,
- Changes in the type and quality of the food base,
- Changes in microclimates by altering temperature and moisture regimes,
- Changes in flows of energy and nutrients,
- Changes in the availability of cover and increases edge effect, bringing together species that might otherwise not interact, potentially increasing rates of predation, competition and nest parasitism, and
- Increased opportunities for exploitation by humans, such as poaching or illegal collection for the pet trade." (pages 3 and 4)

Habitat Fragmentation and the Effects of Roads on Wildlife and Habitats

Watson, Mark L., Habitat Specialist Conservation Services Division New Mexico Department of Game and Fish

Background and Literature Review, January 2005.

<http://www.safepassagecoalition.org/resources/Habitat%20Fragmentation.pdf>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *“Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.”* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Fires do not leave a large road network in place (assuming the blaze was not suppressed otherwise there may be dozer lines, etc.). Logging creates roads that fragment habitat and generally increase human access, both of which affect the use of the land by wildlife. Moreover, roads and logging equipment can become vectors for the dispersal of weeds.”

Ecological Differences between Logging and Wildfire

By Wuerthner, George, forest ecologist and author

Published in *Wuerthner and the Environment*, December 22, 2008

<http://wuerthner.blogspot.com/2008/12/ecological-differences-between-logging.html>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *“Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.”* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Forest fragmentation occurs when large, contiguous blocks of forest are broken up into isolated islands by development, roads, or clearing for agriculture. Just as inbreeding among the royal families of Europe spread hemophilia, forest fragmentation negatively impacts the long term sustainability of both plant and animal communities. Geographic isolation results in inbreeding and diminishes biodiversity.”

A Forest Divided

By Zimmerman, E.A. and P.F. Wilbur

Published in the *New Roxbury Land Trust newsletter*, 2004

<http://www.ourbetternature.org/forestfrag.htm>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. No

new permanent road construction would occur, and maintenance activities would occur on haul routes as need and outlined in the EA.

Road Construction Opposing View “Forest roads are a major source of fine sediment pollution, says Dave Powers, Environmental Protection Agency’s Forest and Rangeland Manager in the Northwest.

“Roads can frequently contribute up to 90 percent of the sediment going into streams, particularly if they’re not properly designed, located and operated,” Powers says.

Roads alter the natural plumbing of a forest. Their hard, flat surfaces collect and channel rainwater. During storms that fast-moving water can carry fine sediment into streams. Plugged culverts and unstable road fill can trigger landslides.

Powers says erosion and other processes naturally move sediment into streams — often a mix of gravel, boulders, and smaller material. However, roads can deliver unhealthy and unnatural amounts of mud and fine sediment, causing problems for salmon and trout.”

Clean Water Act's Next Role Could Play Out On NW Logging Roads

By Templeton, Amelia

Published by Oregon Public Broadcasting, Aug. 15, 2012

<http://www.opb.org/news/article/replumbing-the-forest/>

FS Response: See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Road Construction Opposing View “Unpaved roads can be sources of chronic sediment to streams in forested watersheds. The bare soil on forest roads is subjected to rainfall and overland flow, which lead to surface erosion.”

PREDICTING SEDIMENT DISCHARGE FROM FOREST ROADS: THE ROLE OF SURFACE RUNOFF AND RAINFALL INTENSITY

By: Joseph R. Amann, Hydraulic Engineer, WEST Consultants, Inc. and Dr. Arne Skaugset, Associate Professor, Department of Forest Engineering, Oregon State University

https://www.gcmrc.gov/library/reports/physical/fine_sed/8thfisc2006/8thfisc/session%202a-1_amann.pdf

FS Response: Research on amount of sediment produced and delivered to a stream in western Oregon. See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Road Construction Opposing View “These roads are providing public access to forests, and they also have high aquatic and environmental risks,” Uniack said. “Sediment goes into rivers and watersheds and affects people and fish.”

Sediment is especially dangerous for salmon and steelhead species — many of which are listed as endangered or threatened. Sediment:

- Irritates their delicate gills. As silt builds up on fishes’ gills, they open and close them excessively to try to get rid of it. Quite literally, it makes them cough.
- Raises fishes’ blood sugar levels and changes the way their bodies regulate water. Such stressors can affect their ability to grow, to reproduce, to resist disease and, ultimately, to survive.

The physiological impacts are bad enough, but sediment also can make fish a little psycho, or in scientific terms, sediment can have negative behavioral effects.”

Maintenance Cutbacks For Forest Roads Mean More Sediment For Streams

Stewart, Bonnie

Oregon Public Broadcasting, Aug. 14, 2012

<http://www.opb.org/news/article/budget-cuts-in-federal-forest-road-maintenance-hur/>

FS Response: Article outlining how road maintenance budgets are shrinking and causing sediment introduction into streams. Not relevant to this project.

Road Construction Opposing View “Cedarholm et al. (1980) found that fine sediment in salmon spawning gravels increased by 2.6 - 4.3 times in watersheds with more than 4.1 miles of roads per square mile of land area. Matthews (1999) linked increased road densities to increased sediment yield in the Noyo River. Regional studies from the interior Columbia River basin (Haynes et al., 1996) show that bull trout do not occur in watersheds with more than 1.7 miles of road per square mile (see figure below) and NOAA (1995) set limits for road densities on National Forest lands in the Columbia

River Basin at no more than 2.5 mi./sq. mi. The National Marine Fisheries Service (1996) guidelines for salmon habitat characterize watersheds with road densities greater than 3 miles of road per square mile of watershed area (mi/sq mi) as "not properly functioning", while "properly functioning condition" was defined as less than or equal to 2 mi./sq. mi., with no or few stream aide roads.

Based on extensive field data analysis of road densities and the occurrence of bull trout the USFS characterizes road density levels of greater than 1.7 mi./sq. mi. as High and greater than 4.7 mi./sq. mi. as Extremely High, as indicated in this figure, from Haynes et al. (1996).”

Roads and Erosion

By Web, Kris

Published in krisweb, 2011

<http://www.krisweb.com/watershd/roads.htm>

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 *“Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.”* No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.



Road Construction Opposing View “Notwithstanding past efforts to stabilize roads, large landslides from roads still cause widespread damage to coastal streams. It appears that only a program of road obliteration that returns hillsides to their original contour will prevent sliding from occurring during periodic high rainfall events.”

“Landsliding during infrequent, catastrophic events is often excused as an “act of God.” This survey shows that it is acts of man that create the conditions nature exploits. The Forest Service should develop training materials to ensure that its land managers thoroughly understand the consequences of roading and logging in erosive areas subject to unpredictable, episodic high rainfall events. We cannot afford to have managers learn by their own experience; they need to learn their predecessors’ lessons.”

AERIAL LANDSLIDE SURVEY OF MAPLETON RANGER DISTRICT FOLLOWING RAINSTORM OF FEBRUARY, 1996 February 14, 1996

Association of Forest Service Employees for Environmental Ethics
<http://members.epud.net/~jpreed/landsl.html>

FS Response: Link broken.

Road Construction Opposing View “Forest roads deform range, cutting surface and subsurface water flow, reduced vegetation cover, causing soil compaction and erosion and finally cause sediment production in the watershed areas (Tague and Band 2001). Soil erosion is the most significant contributor of off-site ground water pollution on a global scale with most of the contaminants originating within an anthropogenic setting (Marsh and Grossa 1996). Forest road sediment production causing erosion and soil loss, which creates maintenance and repair costs are causing pollution of water resources in forest streams and negative effects on breathing and generation aquatics and finally accumulation behind the dams and reduce its effective life (USDA 2000, Akay et al. 2008, Khalilpoor et al. 2010).” (pgs 3 and 4)

“The total soil erosion on the Soil cutslope was 13 and 270 times higher than those from the roadbed and the natural forest, respectively. The results can help forest managers to know that cutslopes can be considered the main source of sediments on the forest roads and to employ suitable methods to reduce sediment production.”

Measuring Runoff and Sediment Production from Forest Roads

Published by Research Gate, April 2013

[https://www.researchgate.net/publication/253328114_Measuring_Runoff_and_Sediment_Produ](https://www.researchgate.net/publication/253328114_Measuring_Runoff_and_Sediment_Production_from_Forest_Roads)
[ction from Forest Roads](https://www.researchgate.net/publication/253328114_Measuring_Runoff_and_Sediment_Production_from_Forest_Roads)

FS Response: Please refer to Appendix A of the EA for design criteria. Design criteria for log haul are included to reduce sediment inputs from roads in streams. See the EA at 2-3 “Temporary roads are roads authorized by contract, permit, lease, or other written authorization, or emergency operation not intended to be part of the forest transportation system and not necessary for long-term resource management. Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity. No new temporary roads would be constructed within riparian reserves. Temporary roads would be closed and restored after salvage and related activities are complete. About 13.5 miles of temporary roads would be constructed and rehabilitated after use.” No new permanent road construction is proposed with this project. Additionally, effects to wildlife, soils and hydrology can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Forest roads can cause a variety of impacts on local wildlife that may lead to extirpation: facilitating the spread of invasive organisms, causing death or harm by vehicle strikes, and changing the behavior of animals to their detriment. Roads create improved access to forests, which can increase predation rates from hunters. Animals may move to avoid traffic noise, increasing their vulnerability to predation by other animals. One of the most significant impacts of forest roads is on water quality, through both catastrophic and chronic sources of water pollution, primarily from sediment.”

The Potential Effects of Forest Roads on the Environment and Mitigating their Impacts

Integrating Forestry in Land Use Planning (P Bettinger, Section Editor), October 3, 2016

<https://link.springer.com/article/10.1007/s40725-016-0044-x>

FS Response: See the overall response in that no new permanent roads would be constructed. See the EA at 2-3. *“Temporary roads are not intended to be included as part of the forest road atlas, as they are managed by the projects or activities under which they are authorized and decommissioned at the conclusion of the authorized activity.”* Additionally, effects to wildlife can be seen in Chapter 3 of the EA.

Road Construction Opposing View “Sediment production rates varied greatly between years and between road segments. Sediment production rates from native surface roads were 12-25 times greater than from rocked roads. On average, recently-graded roads produced twice as much sediment per unit of storm erosivity as roads that had not been recently-graded. Unit area erosion rates were 3-4 times higher in the first wet season than in either of the following two wet seasons, as the first wet season had near normal precipitation and a higher proportion of rainfall. An empirical model using the product of road segment area and slope ($A \cdot S$), annual erosivity, and the product of road segment area and a binary variable for grading ($A \cdot G$) explained 56% of the variability in sediment production. Road sediment production is best mitigated by rocking native surface roads, decreasing sediment transport capacity by improving and maintaining drainage, and avoiding sites where unusual soil characteristics increase road surface or ditch runoff.”

MS Thesis-- SEDIMENT PRODUCTION AND DELIVERY FROM FOREST ROADS IN THE SIERRA NEVADA, CALIFORNIA

By Drew Bayley Rogers Coe, Spring 2006

http://www.bof.fire.ca.gov/board_committees/monitoring_study_group/msg_supported_reports/2006_supported_reports/drewcoe_finalthesis.pdf

FS Response: See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Road Construction Opposing View “Forest roads are also associated with direct stream contribution of sediment due to road surface erosion and sediment delivery at stream crossings (Bilby *et al.*, 1989; Fransen *et al.*, 2001; Lane and Sheridan, 2002) as well as increasing the frequency of landslides (Reid and Dunne, 1984; Fransen *et al.*, 2001; Wemple *et al.*, 2001). Forest road generated sediment can be transported along the road’s surface, in rivulets, or its ditches, where it can be delivered at stream crossings. Stream crossings were selected for study in this project because of their consistent occurrence in the literature and the ease in designating them as a point source for increased sediment levels downstream.

Roads can contribute fine sediment to streams during construction, use and maintenance as well as decommissioning. A range of literature from around the world provides insight into the magnitude of the disturbance. For example, Burns (1970) indicated that sediment loads in a harvested California basin were greatest during the road construction period although they were sustained for several years with continued harvesting. Beschta (1978) identified a 150% increase in the sediment load after road construction while Bilby *et al.*, (1989) identified that 680 of 2000 road drainage points directly contributed sediment to streams, and that most of those sites were found on first or second-order channels. Sediment loads can be highest during road construction and can contribute as much sediment to streams as landslides (Cederholm *et al.*, 1981). Close to 80% of the sediment eroded from tropical forestry landings and road surfaces was delivered to stream channels within 16 months of construction (Sidle *et al.*, 2004). Sediment generation can be highest the year after road construction (Megahan *et al.*, 2001) but roads will continue to deliver sediment throughout their active usage period. Reid and Dunne (1984) found that a highly active road contributed 130 times more sediment than lower usage roads. Road maintenance, including grading and ditchline vegetation removal, can increase soil erosion potential. Luce and Black (1999) identified a seven-fold increase in erosion from recently de-vegetated ditches compared to those where vegetation was left intact.” (pgs 90 and 91)

Fine Sediment Deposition at Forest Road Crossings: An Overview and Effective Monitoring Protocol

John F. Rex Ph.D. and Ellen L. Petticrew Ph.D., *University of Northern British Columbia*
Canada, 2011

<http://cdn.intechweb.org/pdfs/20913.pdf>

FS Response: See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Road Construction Opposing View “Unpaved roads often are a major source of sediment to streams in forested watersheds, and an increase in sediment production and delivery can adversely affect the overall health of a stream.” (pg ii)

Unpaved roads typically have a high percentage of exposed mineral soil that is susceptible to detachment and transport. In forested watersheds, unpaved roads are often a major source of sediment to streams (Reid and Dunne, 1984; Swift, 1988; Bilby et al., 1989; Luce and Black, 1999; Ketcheson et al. 1999; Coe, 2006). Roads can deliver a large amount of sediment to streams relative to their surface area even during low to moderate rainfall events (Ziegler and Giambelluca, 1997; Chappell et al., 1999; Ziegler et al., 2004; Cafferata et al., 2007).” (pg 96)

MS Thesis-- **SEDIMENT PRODUCTION AND DELIVERY FROM HILLSLOPES AND FOREST ROADS IN THE SOUTHERN SIERRA NEVADA, CALIFORNIA**

By Allison K. Stafford , Spring 2011

http://www.nrel.colostate.edu/assets/nrel_files/labs/macdonald-lab/dissertations/Stafford-thesis-31-March-2011.pdf

FS Response: See the EA at 3-69 for a discussion of the transportation system and effects. See also 3-72 for effects to soils and 3-89 for effects to hydrology.

Anyone who has read the science above who believes accumulating volume is worth adding to the 413,000 miles of road shouldn't be making decisions for national forests.

Some of you will reject this information because you will “only be constructing temporary roads.” Unless a temporary road is completely obliterated the road isn't temporary. It becomes

a tragic, outsloped linear sediment source. Of course the few USFS employees who are clinically obsessed to accumulate as much volume as possible don't care about aquatic resource health do they?